

# **Coastal Infrastructure Management Plan**

Safata District



## ***Implementation Guidelines***

August 2002

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## **Glossary**

<b>Coastal Hazard Zones -</b>	Defined areas landward of the coast which are or are considered likely to be subject to the effects of hazards over a defined assessment period. In this study, reference is made to four coastal hazard zones: ASCHs (areas sensitive to coastal hazards); CEHZs (coastal erosion hazard zones); CFHZs (coastal flood hazard zones) and CLHZs (coastal landslip hazard zones).
<b>"Do Minimum" option -</b>	A Management option that involves continuing with the present maintenance and upgrading programme on an as and when required basis.
<b>Hazard -</b>	A source of potential harm or a situation with a potential to cause loss.
<b>Infrastructure -</b>	Built structures and networks which support the national, regional or local community.
<b>Lifeline infrastructure</b>	Infrastructure that contributes directly to the survival of the community and its ability to respond and recover at the time of extreme events.
<b>Secondary infrastructure</b>	Infrastructure that contributes to the every-day development of the community.
<b>Implementation Guidelines -</b>	A document to guide land use and resource practices to achieve specified goals, objectives and policies and provide a framework for the implementation of defences and works.
<b>Issue -</b>	A specific concern regarding both cause and effect.
<b>Land and Resource Use -</b>	The use of land and resources by the community for social, economic or other benefit (e.g. land use includes areas used for villages or crops, resource use includes activities such as sand mining, gravel extraction or fishing).
<b>Monitoring -</b>	Process of measuring the effectiveness or impacts of projects and works against predicted standards, levels or outcomes.
<b>Resilience -</b>	The ability to be adaptive, responsive and quick to recover.
<b>Community Resilience -</b>	The ability for the community to be adaptive, responsive and quick to recover from the adverse effects of hazard.
<b>Natural Resilience -</b>	The ability of natural systems to be adaptive, responsive and quick to recover from coastal processes or hazards.
<b>Risk -</b>	The chance of something happening that will have an impact on objectives. It is measured in terms of consequence and likelihood. In the Coastal Infrastructure Management Plan context it is the likelihood that infrastructure will be subject to coastal hazards and the potential for loss of property, life or land due to natural processes.
<b>Safata MPA</b>	The District of Safata has established a community-based, multi-use Marine Protected Area (MPA). All decisions for the MPA are made by the Safata MPA District Committee and the MPA District Centre is located at Lotofaga (phone 72965). The Safata MPA Management Plan is available from the Division of Environment and Conservation, DLSE, Ground Floor, Government Building, Apia.
<b>Stakeholders -</b>	Those people and organisations who may affect, be affected by, or perceive themselves to be affected by, a decision or activity. The term stakeholder may also include interested parties.
<b>Strategy -</b>	Direction or course of action to achieve a defined vision.
<b>Susceptibility -</b>	The degree to which infrastructure at risk is likely to be damaged by coastal hazards and how easy/difficult, expensive/cheap it is to replace. In the context of the CIM Plan the term susceptibility is equivalent to the term vulnerability as the Samoan phrase for both susceptibility and vulnerability is the same.
<b>Vision -</b>	A desired destiny.

### **Acknowledgement**

This plan reflects the partnership between each of the villages within the District and the Government of Samoa in the management of coastal infrastructure. Its preparation involved substantial contributions from many people; in particular, the village representatives to the District Committee, the support of the Ministry of Internal Affairs and the Pulenu'u in each village, without whom the plan would not have been completed.

In addition we also wish to recognise the significant contribution of the key government stakeholders, in particular:

- |                              |  |
|------------------------------|--|
| • Ministry of Works          | • Ministry of Agriculture, Forestry, Fisheries and Meteorology |
| • Samoa Water Authority      | • Samoa Land Corporation                                       |
| • Electric Power Corporation | • Samoa Ports Authority  |
| • Samoa Telecommunications   |  |

On behalf of the Department of Lands Survey and Environment and Beca International Consultants, we extend our sincere thanks to each of these groups for enabling this plan to be developed.

## **Introduction to the CIM Plan**

### **The Strategic Vision**

The District Coastal Infrastructure Management (CIM) Plan for Safata District has been prepared as part of the Government of Samoa's Infrastructure Asset Management Programme (IAMP). The CIM Plan is one of the primary means of implementing the CIM Strategy, which was formally approved by the Government of Samoa in February, 2001, as providing the Strategic direction for the management of infrastructure (both public and private) within the coastal area.

The Strategy has as its central vision "Resilience – Coastal Infrastructure and Communities Resilient to Natural Hazards". The CIM Plan takes this vision and provides the practical tools with which the communities and the government, in partnership, can implement the Strategy.

*To be resilient is to be adaptive, responsive and quick to recover so that communities are environmentally, socially and economically sustainable.*

(CIM Strategy, January 2001).

### **The Aim of the CIM Plan**

The Aim of the CIM Plan is to help communities and government improve resilience by identifying actions and solutions. Not all the solutions may be actioned immediately but the plan will ensure that issues and options are identified for the long-term improvement in resilience of both infrastructure and communities.

The CIM Plan will:

1. Improve the community's awareness of coastal hazard risks;
2. Enable the community and infrastructure providers to reduce coastal hazard risks in villages;
3. Enable the community and infrastructure providers to better adapt, respond and recover from cyclones.

### **Structure of the Plan**

The CIM Plan consists of two parts each serving a separate and distinct purpose.

- *Plan Development*, which describes the process undertaken in preparing the CIM Plan in conjunction with representatives of the Communities involved and the Government and other stakeholders with interests in the Plan area.
- *Implementation Guidelines*, which describes the Plans and Actions recommended as outcomes of the process, together with the partner responsible for implementing these outcomes. The participants of the CIM Plan preparation process are acknowledged in the *Implementation Guidelines*.

## **Implementation Guidelines**

### **Purpose of the Implementation Guidelines**

The Implementation Guidelines describe the solutions proposed that will increase the resilience of the villages in the Plan area and the ways these solutions can be implemented. The solutions are presented for each of the infrastructure items that have moderate to low resilience. Where one solution will provide benefits to other items of infrastructure these "Other Benefits" are also noted. Implementation is considered to be the joint responsibility of both the villages and the government in partnership. The government is responsible for the provision of national and district "Public", infrastructure, while villages are responsible for local and community infrastructure. The responsibility for implementing the proposed actions is also defined. Solutions for both District infrastructure and Village infrastructure, and the responsibility of both partners, should be considered together as they combine to provide for the integrated management of all coastal infrastructure.

The solutions for village infrastructure will usually be the responsibility of the Village and Families in the village to implement. Advice and resources may be available from government to assist the village in implementing these solutions. In most situations these solutions will also provide benefits to both village **and** district infrastructure and should be considered an integral part of managing coastal infrastructure at both levels.

### **Duration of the Plan**

The CIM Plan should be reviewed at five-yearly intervals. During the Plan period, the solutions implemented will be monitored to ensure that they are effective in improving resilience. Some solutions are likely to take longer than five years to implement and the review will take the progress of these into account.

The review of the *Implementation Guidelines* and the solutions proposed will be undertaken:

1. As part of the Five-yearly CIM Plan review programme.
2. Once implemented, the solutions will be monitored on either an annual or five-yearly basis to check the effectiveness of the solution. Detailed implementation of the solution will determine the monitoring requirements and Key Performance Indicators.

## **Participants in the Plan**

The CIM Plan is a Partnership between the Government of Samoa and the villages within the Plan area. Both partners have responsibility for different levels of infrastructure in the local communities and the Plan gives an integrated approach to the provision of services and improvement of resilience now and in the future.

This Plan incorporates the Faipule District of Safata.

The Committee for the Faipule District of Safata, confirms the participation of the Villages in the preparation of this Coastal Infrastructure Management Plan for Safata District in partnership with the Government of Samoa and its adoption as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy.

### **Village Meetings:**

- Sa'anapu 29 January 2002
- Sataoa 30 January 2002
- Lotofaga 31 January 2002
- Nu'usuatia 1 February 2002
- Vaie'e 7 February 2002
- Fusi 5 February 2002
- Fausaga 6 February 2002
- Tafitoala 7 February 2002
- Mulivai 8 February 2002

### **Village Representatives:**

Hauiseka Neama Faagaga Tamai 3rd.  
Lesu Caeloga  
Pitaana Faagaga G. P. Andreas.  
Elected. Faafaga. Iam.  
Shalefale Tuamasina S. Matacaga. Fotu. Hauiseka  
Fologata. A. Tafitoala, I. Tuama 13  
Lameleli T. Salafaa M. Tolofaelei  
Ak. Salanipo Ak. Faasaua Viga  
Afae.

The CIM Plan Committee representing all of the Villages in the area met on 11 February 2002.

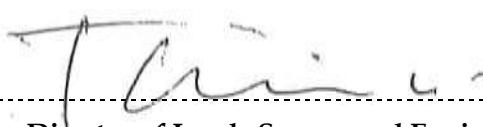
Comments on the draft CIM Plan were received from the Committee on 16 April 2002 and 6 June 2002.

### **Government Departments and Corporations:**

- Department of Lands, Survey and Environment
- Ministry of Internal Affairs
- Treasury Department
- Public Works Department
- Samoa Water Authority
- Electric Power Corporation
- Samoa Communications Ltd
- Samoa Land Corporation

The Department of Lands, Survey and Environment, as lead Department of Government, on behalf of the participating Government Departments and Corporations, confirms the participation of the Government of Samoa in the preparation of this Coastal Infrastructure Management Plan and its adoption as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy.

Signed:

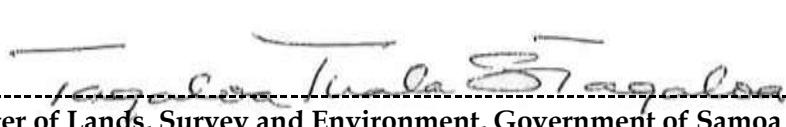
  
Director of Lands Survey and Environment

Date:

31.07.02

**The Government of Samoa adopts the Coastal Infrastructure Management Plan for the Faipule District of Safata as a Management Plan for the implementation of the Coastal Infrastructure Management Strategy (CIMS).**

Signed:

  
Minister of Lands, Survey and Environment, Government of Samoa

## **1 Safata District Infrastructure**

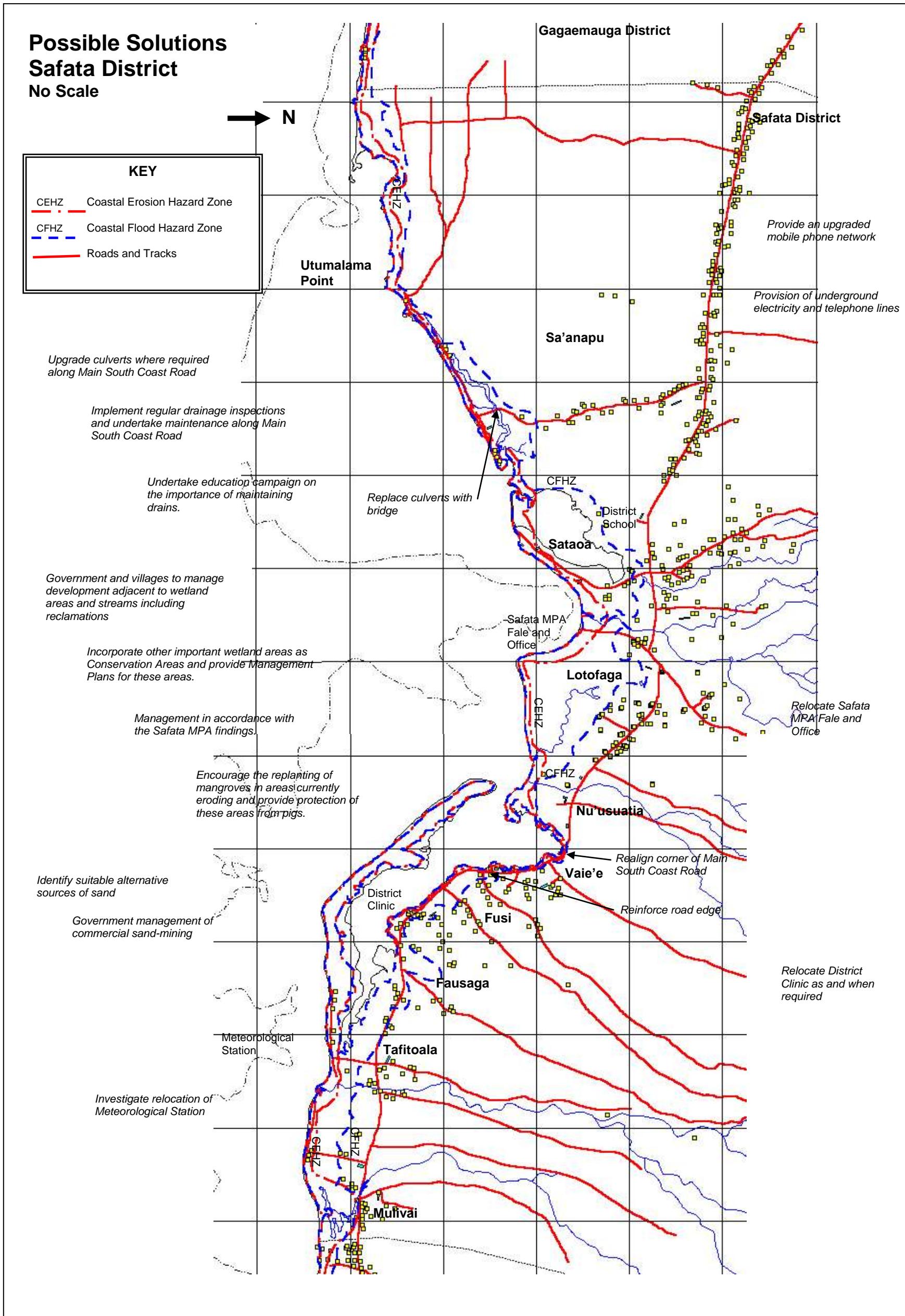
<b>Infrastructure</b>	<b>Best Solutions and Other Solutions Proposed</b>	<b>Other Benefits</b>	<b>Implementation Guidelines</b>
Main South Coast Road	<ul style="list-style-type: none"> <li>To implement regular drainage inspection programme in the District and to ensure that maintenance is undertaken regularly.</li> <li>To undertake a local education programme on the importance of maintaining drains.</li> <li>Upgrade drainage culverts where required under Main South Coast Road.</li> <li>Realign corner at Vaie'e and incorporate armouring against erosion and provision for the spring.</li> <li>To provide armouring along the road edge where it is next to the estuary at Fusi.</li> </ul> <p><i>Responsibility: Public Works Department</i></p> <ul style="list-style-type: none"> <li>To plant and protect mangroves in the inlets encroaching on the road.</li> </ul> <p><i>Responsibility: Department of Lands, Survey and Environment/Villages</i></p>	<ul style="list-style-type: none"> <li>Water</li> <li>Electricity</li> <li>Telephone</li> <li>Village houses</li> </ul>	<ul style="list-style-type: none"> <li>Undertake inspection of culverts along Main South Coast Road.</li> <li>Identify areas of flooding along Main South Coast Road and arrange programme for remedying problem including upgrading culverts and clearing/maintaining roadside drains.</li> <li>Implement education programme on importance of maintaining roadside drains.</li> </ul> <ul style="list-style-type: none"> <li>Joint responsibility of the partners to prepare planting programme.</li> <li>Ensure newly planted areas are fenced and protected from intrusion by domestic animals.</li> </ul>
Local telephone lines	<ul style="list-style-type: none"> <li>Provision of underground telephone lines.</li> </ul> <p><i>Responsibility: Samoa Communications Ltd</i></p> <ul style="list-style-type: none"> <li>Provide an upgraded mobile telephone network</li> </ul> <p><i>Responsibility: Samoa Communications Ltd</i></p>	<ul style="list-style-type: none"> <li>Village</li> </ul>	<ul style="list-style-type: none"> <li>Include provision for underground telephone lines where practical and feasible in future programmes.</li> <li>Include provision for expansion of mobile telephone network in future programmes.</li> </ul>
Local electricity lines	<ul style="list-style-type: none"> <li>Provision of underground electricity lines where practical.</li> </ul> <p><i>Responsibility: Electric Power Corporation</i></p>	<ul style="list-style-type: none"> <li>Village</li> </ul>	<ul style="list-style-type: none"> <li>Include provision for underground electricity lines where practical and feasible in future programmes.</li> </ul>
Meteorological Station	<ul style="list-style-type: none"> <li>Relocate to a safe area outside the CEHZ and the CFHZ.</li> </ul> <p><i>Responsibility: Meteorological Service</i></p>		<ul style="list-style-type: none"> <li>Investigate alternative locations that achieve the collection of meteorological information in the vicinity and prepare for relocation as and when required.</li> </ul>
Safata MPA Office and Fale	<ul style="list-style-type: none"> <li>Relocate to a safe area outside the CEHZ and the CFHZ.</li> </ul> <p><i>Responsibility: Department of Lands, Survey and Environment</i></p>		<ul style="list-style-type: none"> <li>Determine length of Safata MPA and investigate relocation or removal of the Office and Fale as and when access becomes no longer practical.</li> </ul>
District Clinic	<ul style="list-style-type: none"> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding</li> </ul> <p><i>Responsibility: District/Department of Health</i></p>	<ul style="list-style-type: none"> <li>Village</li> </ul>	<ul style="list-style-type: none"> <li>District decision when building to provide long-term protection from erosion and flooding.</li> <li>District decision to relocate in the long-term.</li> </ul>
Mangrove Conservation Areas	<ul style="list-style-type: none"> <li>Ensure Management Plans are in place that include management of development within the Conservation Area as well as on land adjoining the area.</li> <li>Management in accordance with the Safata MPA project findings.</li> </ul> <p><i>Responsibility: Department of Lands, Survey and Environment/Villages</i></p> <ul style="list-style-type: none"> <li>Replace existing culverts through Sa'anapu wetland with structure that maintains tidal flow.</li> </ul> <p><i>Responsibility: Village/PWD</i></p>	<ul style="list-style-type: none"> <li>Village</li> </ul>	<ul style="list-style-type: none"> <li>Joint responsibility of the partners to prepare Management Plans for the conservation of the areas.</li> <li>Adoption of the Safata MPA project outcomes.</li> <li>Preparation of Environmental Impact Assessments for any work to be carried out in or adjacent to the Conservation Areas before the work is started.</li> </ul> <ul style="list-style-type: none"> <li>Preparation of Environmental Impact Assessments prior to work being carried in order to ensure adverse effects on the mangroves are appropriately managed.</li> </ul>
Other Wetlands	<ul style="list-style-type: none"> <li>Government and villages to manage development adjacent to wetland areas and streams including reclamations, to minimise further adverse environmental effects of encroachment and land-use activities.</li> <li>Incorporate other important wetland areas as Conservation Areas and provide Management Plans for these areas.</li> <li>Encourage the replanting of mangroves in areas currently eroding and provide protection of these areas from pigs.</li> <li>Management in accordance with the Safata MPA project findings.</li> </ul> <p><i>Responsibility: Department of Lands, Survey and Environment/Villages</i></p>	<ul style="list-style-type: none"> <li>Village</li> </ul>	<ul style="list-style-type: none"> <li>Joint responsibility of the partners to prepare Management Plans for the conservation of the areas.</li> <li>Adoption of the Safata MPA project outcomes.</li> <li>Preparation of Environmental Impact Assessments for any work to be carried out in or adjacent to the Conservation Areas before the work is started.</li> <li>Ensure newly planted areas are fenced and protected from intrusion by domestic animals.</li> </ul>
All infrastructure	<ul style="list-style-type: none"> <li>Government to manage commercial sandmining in the District in partnership with villages.</li> <li>Identify alternative sustainable sources of sand for commercial supply.</li> </ul> <p><i>Responsibility: Department of Lands, Survey and Environment/Villages</i></p> <p><b>Note:</b> on 4 December 2001, the Safata MPA committee banned commercial sand mining in the District.</p>	<ul style="list-style-type: none"> <li>District</li> </ul>	<ul style="list-style-type: none"> <li>Identify specific sites for near shore sustainable sand mining to meet commercial demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Government to determine commercial sandmining permit applications only after full consideration of the EIA presented and the actual and potential effects on the location and adjacent land and villages.</li> </ul>

**Note:** Refer to Maps to see proposed alignments and locations of intervention solutions.

## Further Issues Raised During the CIM Plan Process

The following issues have been raised in consultation but fall outside the scope of the CIM Plan as they relate to infrastructure that falls outside the coastal area or is not at risk from coastal hazards. The issues are recorded for further investigation by the responsible agencies so that they may programme a suitable response as part of their Annual Plan and budget processes.

Issue	Responsibility	Comment
Main South Coast Road including Single-lane Bridges and the narrow width of the road	Public Works Department	The Bridges and road are not generally at risk from coastal hazards and therefore the issues raised regarding the safety of the bridges and the width of the road lie outside the scope of this Coastal Infrastructure Management Plan. However, as these issues have been raised in consultation as a matter of road safety they are recorded as an item for further investigation by the Public Works Department.
Main South Coast Road - Mulivai Ford	Public Works Department	The ford reinforces the roadway as it crosses an overland flow-path. The ford is at ground level and does not have culverts under it. It does not prevent sediment from being transported to the lagoon and it is not considered that it needs to be replaced. However, during major storms it would be flooded and become impassable interrupting "lifeline" access around the South Coast.  The issue is recorded as an item for further investigation by the appropriate agencies.
Water Supply	Samoa Water Authority/Villages	Water is a significant issue in the district and the provision of a reliable supply of water for domestic use is necessary for the health and safety of the community. The existing water supply and distribution networks are not at risk from coastal hazards and therefore the issue lies outside the scope of this Coastal Infrastructure Management Plan.  Possible solutions may include upgrading the existing water supply and distribution networks or the provision of roof water collection tanks to provide for domestic supply.  The issue is recorded as an item for further investigation by the appropriate agencies.



### Safata District



Dangerous corner eroding behind spring.

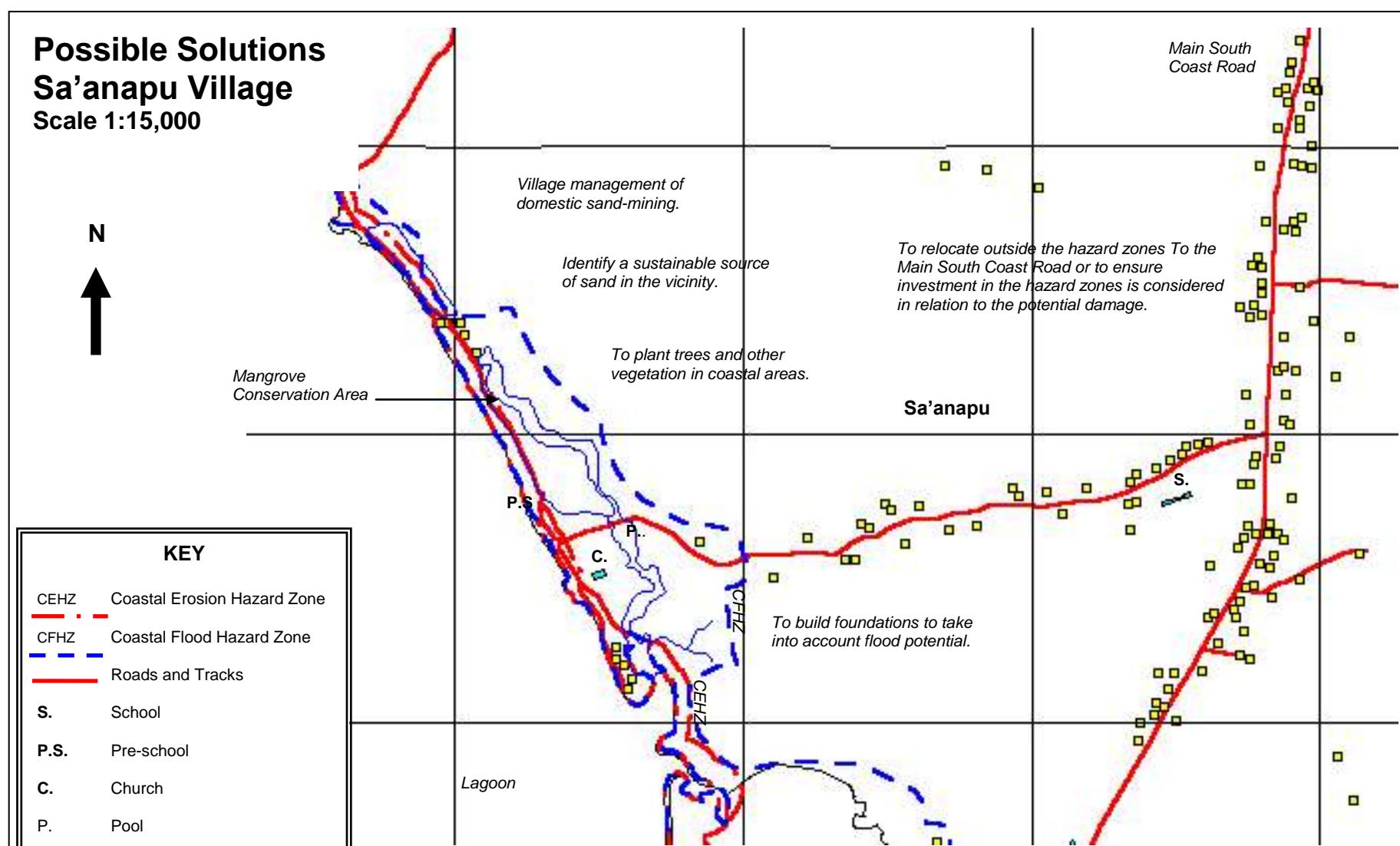


Blocked culvert on Main South Coast Road. Left photo inland side – right photo seaward side.

## 2 Sa'anapu Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, pre-school, road etc and beach fales in CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <b>Responsibility:</b> Village/DLSE</li> <li>Identify a new sustainable source for domestic sand in the vicinity. <b>Responsibility:</b> DLSE</li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul>
	<ul style="list-style-type: none"> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from coastal hazards.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <b>Responsibility:</b> Village/Families</li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>
Village houses and church in the CFHZ	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings.</li> <li>To relocate outside CFHZ when buildings require replacement <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
All infrastructure within the CEHZ and the CFHZ	<ul style="list-style-type: none"> <li>Relocation outside the area to the Main South Coast Road where infrastructure already exists has a very low cost as the main infrastructure is already located in this area. The long-term benefits of relocating when buildings require replacement are very high. An economic analysis is not possible because the cost is so low. <b>Best long-term solution</b> <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Family decision when buildings require replacement or when building new houses to locate outside the coastal hazard zones.</li> </ul>

NOTE: The provision of a 50-year design seawall has been considered as part of this assessment. The estimated cost of a 200m long seawall is \$T81,000. The benefit/cost ratio for such a seawall in front of the main part of the village is 0.44 which means that the costs are more than twice the benefits it provides compared to the *do minimum* option. The cost of protecting commercial development should be considered in conjunction with that development.



### Sa'anapu



Erosion along the beach at Sa'anapu averages about one metre per year.

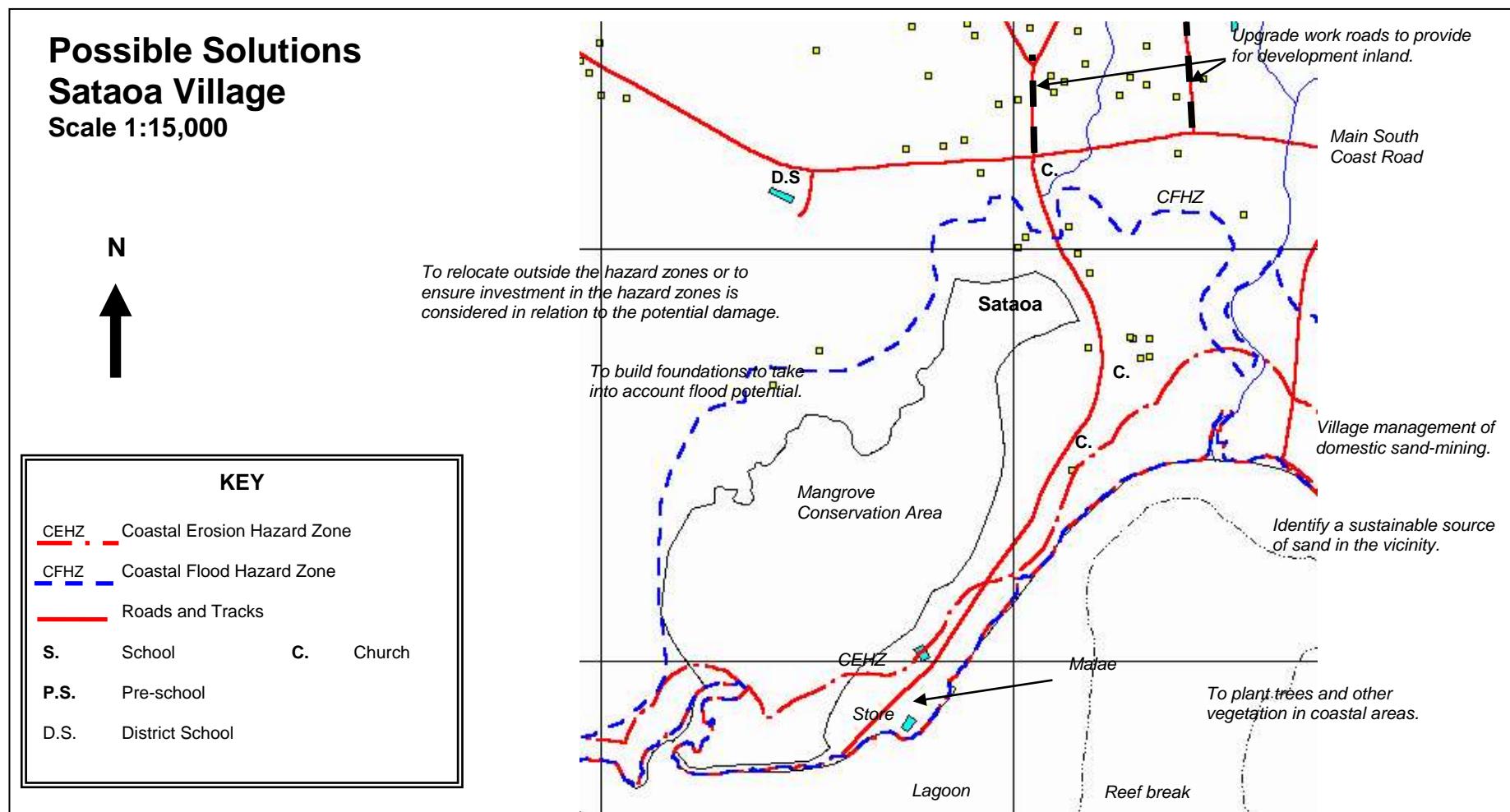


Mangrove Conservation Area at Sa'anapu popular with eco-tourists.

### 3 Sataoa Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, pre-school, road etc and beach fales in CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <b>Responsibility:</b> Village/DLSE</li> <li>Identify a new sustainable source for domestic sand in the vicinity. <b>Responsibility:</b> DLSE</li> </ul>		<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul>
	<ul style="list-style-type: none"> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>
Village houses and churches in the CFHZ	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings.</li> <li>To relocate outside CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal flooding. <b>Responsibility:</b> Village/Families</li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
All infrastructure within the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>To upgrade work roads to provide for development inland. Estimated length of road 500 m Estimated cost \$T65,000 Benefit/cost ratio 1.34 <b>Best long-term solution.</b> <b>Responsibility:</b> Village/PWD</li> </ul>		<ul style="list-style-type: none"> <li>Government to investigate upgrading inland work roads to provide for an alternative development area including undertaking specific consultation and preparing an Environmental Impact Assessment of the proposed upgrade.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>

NOTE: The provision of a 50-year design seawall has been considered as part of this assessment. The estimated cost of a 300m long seawall is \$T122,000. The benefit/cost ratio for such a seawall in front of the main part of the village is 0.50 which means that the costs are twice the benefits it provides compared to the *do minimum* option. Beach replenishment including the provision of groynes to keep the sand on the beach has also been considered in the assessment of solutions for Sataoa Village. The assessment shows that the cost of building groynes and providing for beach replenishment for a 250m length of beach is \$T860,000. The benefit/cost ratio shows that the cost of building and maintaining the beach is about 100 times the benefit it provides to the community.



### Sataoa



Village seawall and tourist development over the water at Sataoa.

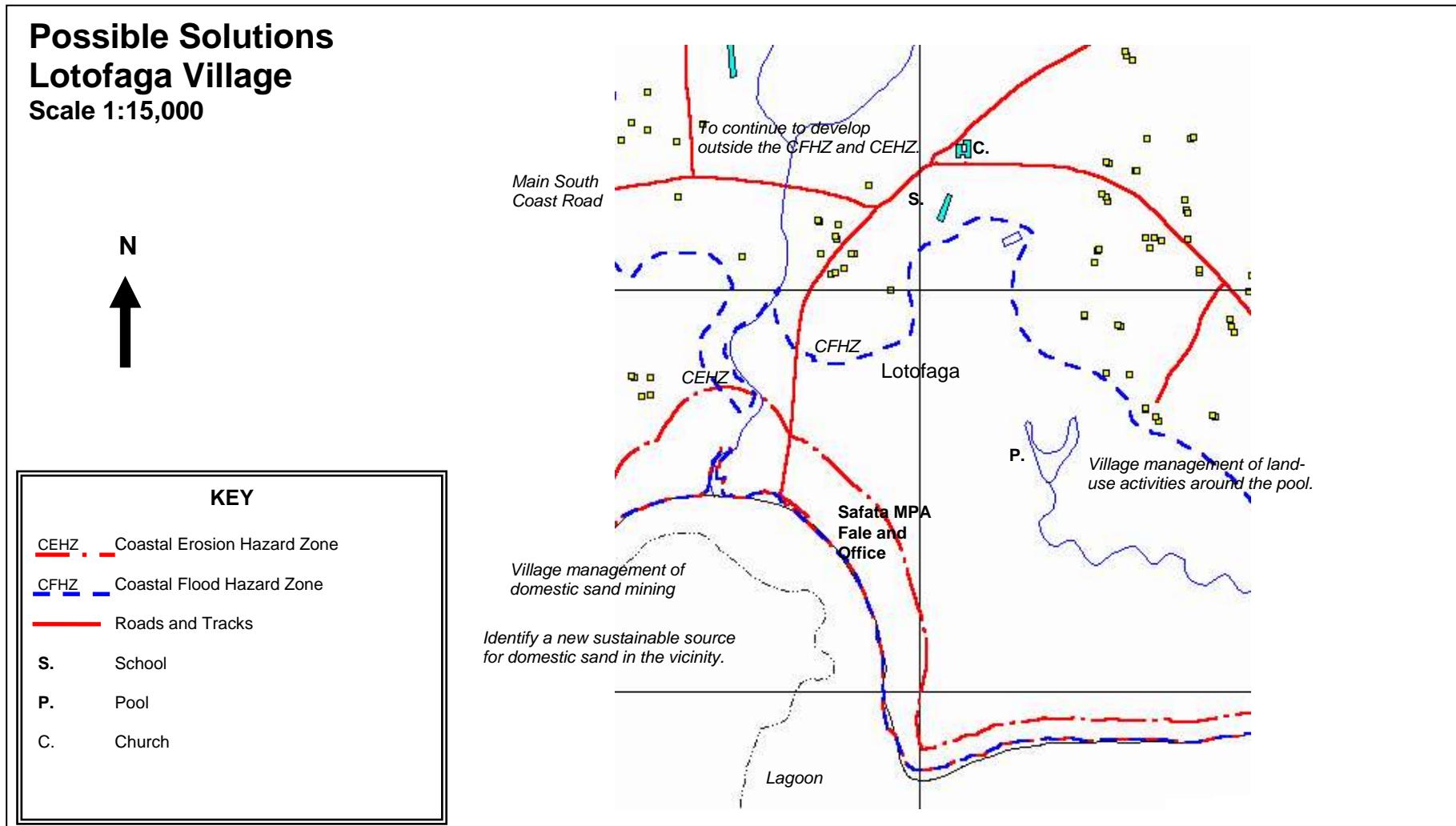


Erosion at the end of the village seawall at Sataoa.

## 4 Lotofaga Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village pool	<ul style="list-style-type: none"> <li>Village management of land-use activities around the pool.</li> </ul> <p><b>Responsibility:</b> Village/Families</p>		<ul style="list-style-type: none"> <li>Village to manage activities around the pool to limit the potential for contamination.</li> </ul>
All village infrastructure	<ul style="list-style-type: none"> <li>Village management of domestic sand mining</li> </ul> <p><b>Responsibility:</b> Village/DLSE</p> <ul style="list-style-type: none"> <li>Identify a new sustainable source for domestic sand in the vicinity.</li> </ul> <p><b>Responsibility:</b> DLSE</p> <ul style="list-style-type: none"> <li>To continue to develop outside of the CEHZ and CFHZ.</li> </ul> <p><b>Best Solution</b></p> <p><b>Responsibility:</b> Village</p>		<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> </ul> <ul style="list-style-type: none"> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul> <ul style="list-style-type: none"> <li>Promote future development outside of the coastal hazard zones</li> </ul>

NOTE: Straightening the river has also been included in the assessment of options. It is considered unlikely that straightening the river would reduce the amount or area of flooding as this area is low-lying and water will naturally flow into it. The maintenance and upgrade of the existing coastal access path has also been considered in the assessment of solutions for Lotofaga Village. The assessment shows that upgrading the access track will not improve the overall level of the resilience for the village and will increase the likelihood of future investment being exposed to damage.



## Lotofaga



Commercial sand-mining site at Lotofaga looking west towards Sataoa.

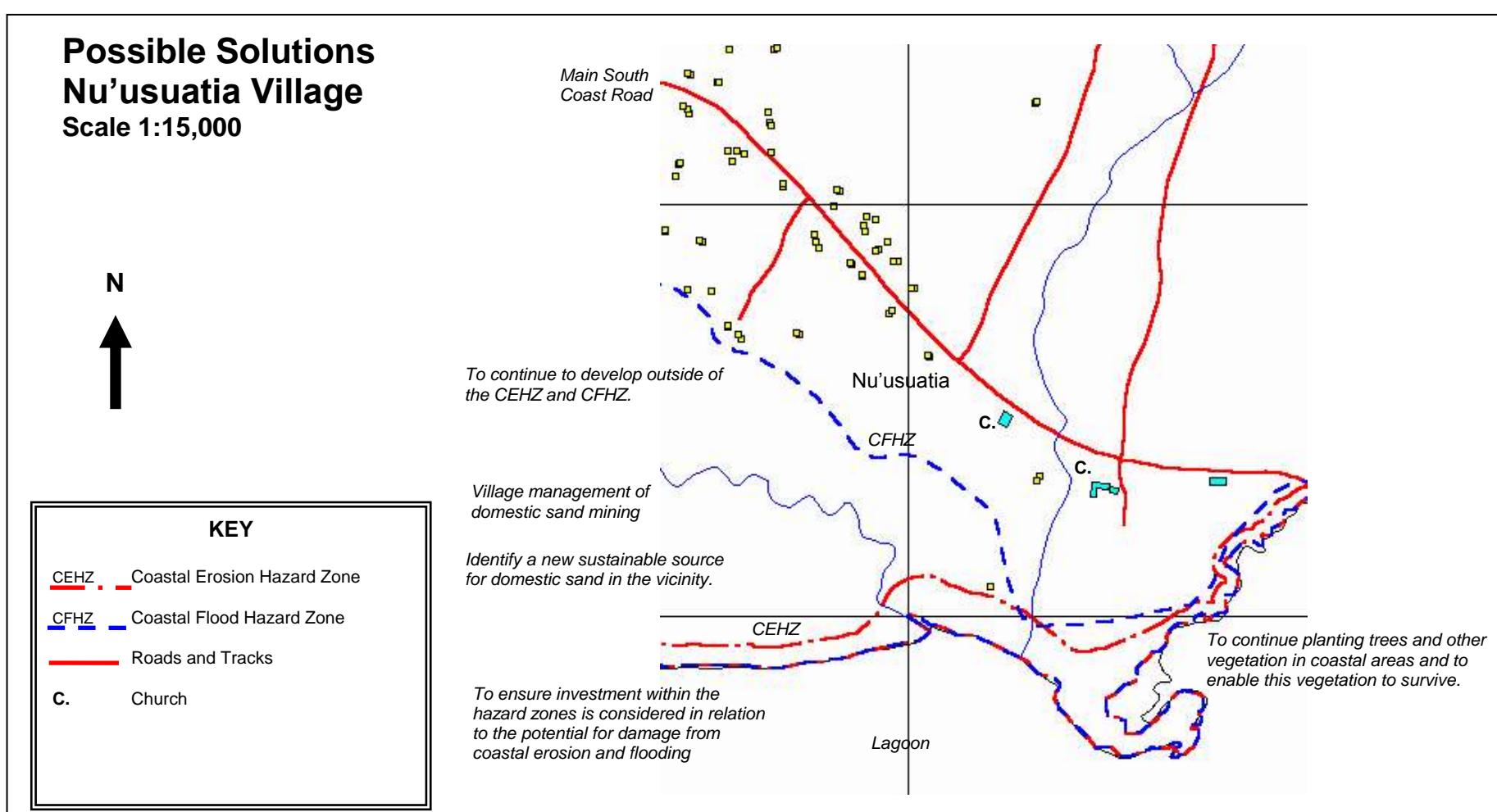


Erosion in front of IUCN Fale and Office at Lotofaga. Average rate of recent erosion estimated at 5 metres per year.

## 5 Nu'usuatia Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Future development in the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <i>Responsibility: Village/DLSE</i></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <i>Responsibility: DLSE</i></li> </ul>		<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> </ul>
	<ul style="list-style-type: none"> <li>To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <i>Responsibility: Village/Families</i></li> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue to develop outside of the CEHZ and CFHZ. <b>Best Solution</b> <i>Responsibility: Village</i></li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building on level of investment appropriate in the hazard zones.</li> </ul>
			<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>
			<ul style="list-style-type: none"> <li>Promote future development outside of the coastal hazard zones</li> </ul>

NOTE: There is no development currently in the coastal hazard zones at Nu'usuatia Village. Any future development proposed for this area should consider the coastal hazard maps and the level of investment proposed. Consideration has also been made of upgrading the inland work roads but there is no need to specifically provide for relocation outside of the Coastal Hazard Zones and therefore these matters do not fall within the scope of the CIM Plan.



### Nu'usuatia



Beach front at Nu'usuatia showing vegetation down to water and recent erosion around coconut palms.

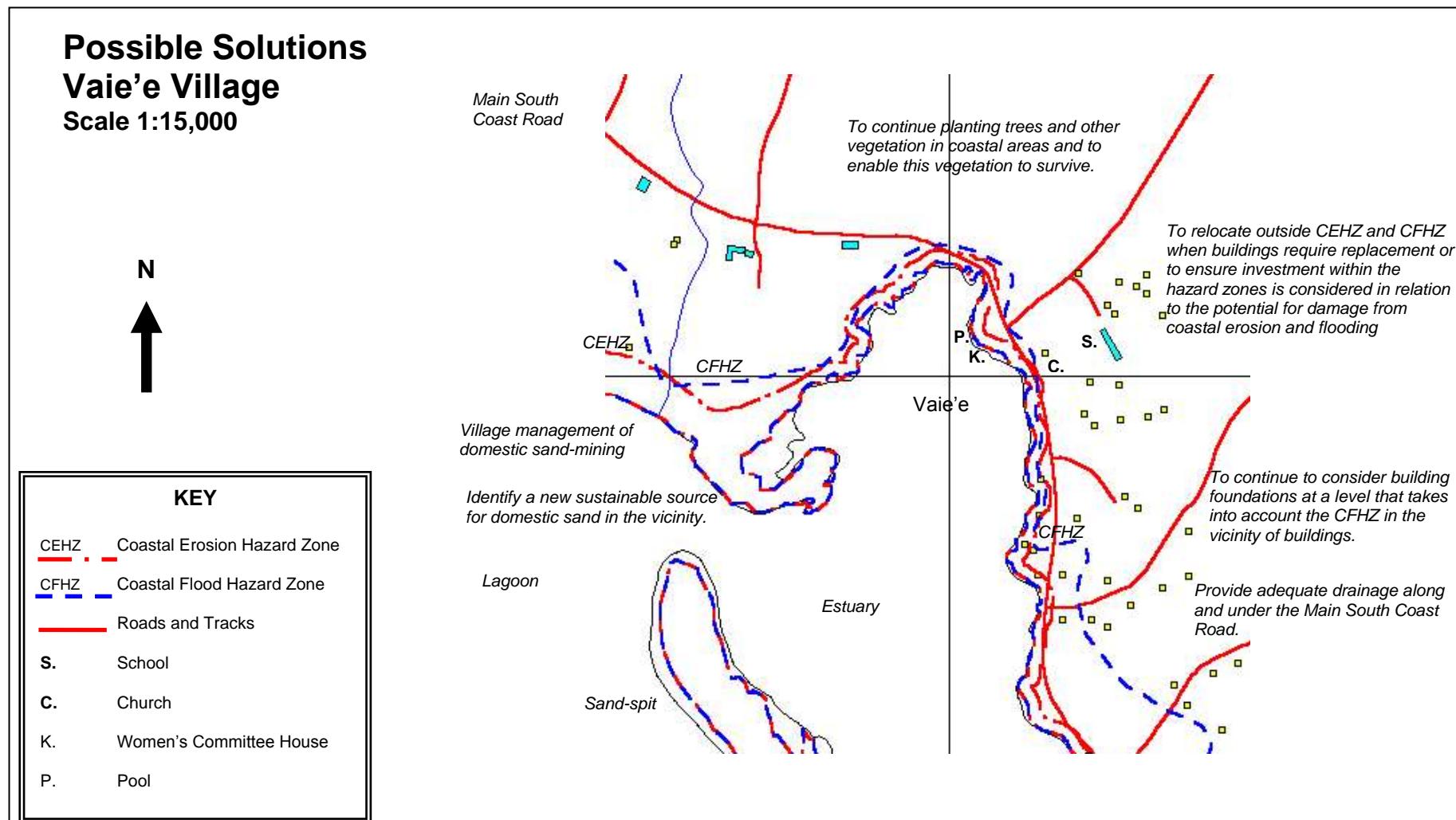


Entry to wetland area at Nu'usuatia.

## 6 Vaie'e Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, pool and the women's committee house in the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <i>Responsibility: Village/DLSE</i></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <i>Responsibility: DLSE</i></li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. <i>Responsibility: Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
	<ul style="list-style-type: none"> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <b>Best Solution.</b> <i>Responsibility: Village/Families</i></li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <i>Responsibility: Village/Families</i></li> </ul>		

NOTE: Consideration has also been given to the development of the sand-spit for tourism, including the construction of a footbridge from the mainland. Any decision on the commercial development of the area must be made by the commercial operators at the time of development subject to a full environmental assessment. A footbridge is not recommended because it is unlikely that it would provide any environmental, economic or social benefit. Alternately developing a new road along the sandspit would also need to take into account the possible negative impacts of construction and the likely increase in sand-mining that will be associated with such a development and the negative effect of such sandmining on the sandspit.



Vaie'e



Sand-spit opposite Vaie'e. Suggested footbridge to cross mouth of the estuary.

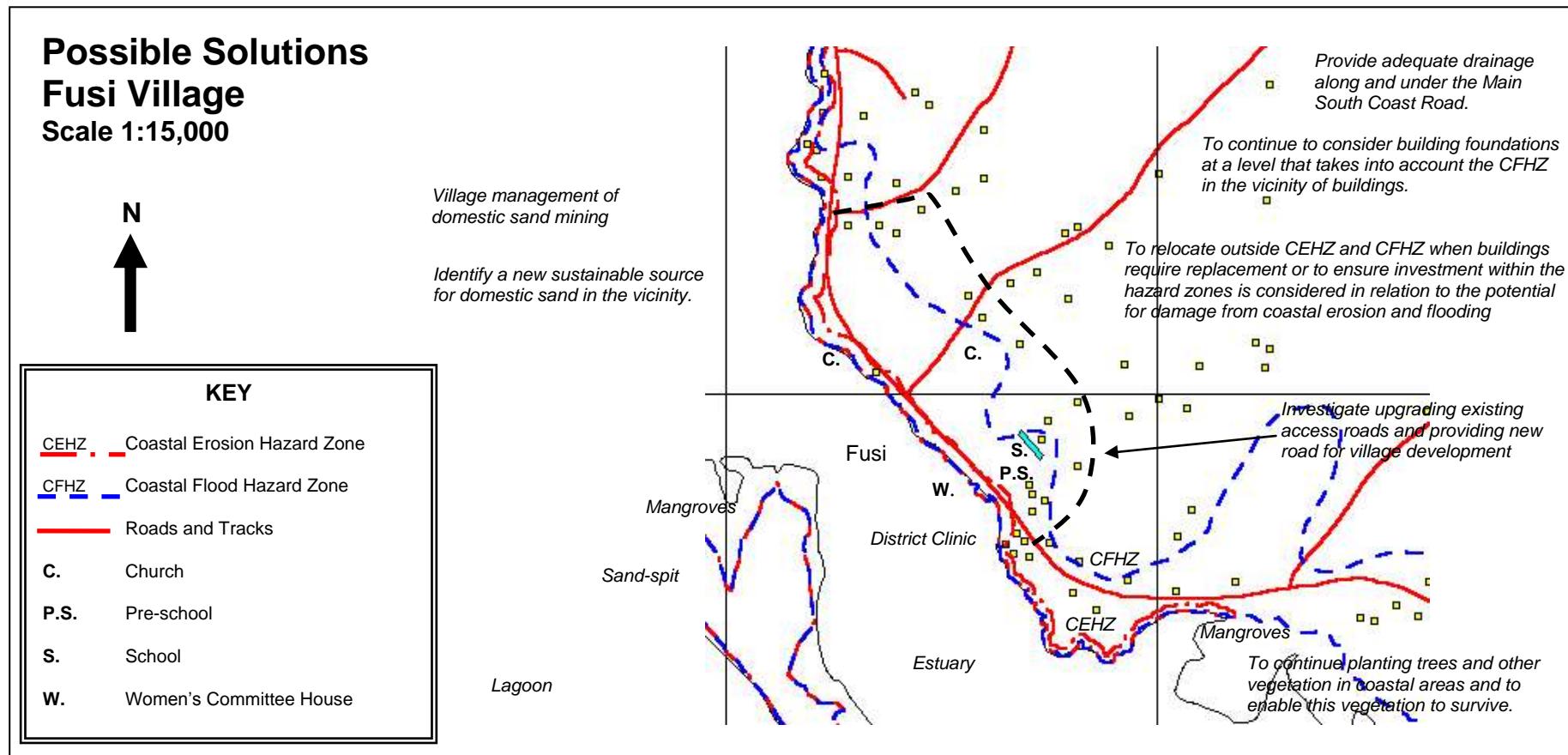


Development along the coast at Vaie'e.

## 7 Fusi Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, women's committee house, church, store, tourism development and a pool in CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <b>Responsibility: Village/DLSE</b></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <b>Responsibility: DLSE</b></li> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. <b>Responsibility: Families</b></li> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <b>Best Solution</b> <b>Responsibility: Village/Families</b></li> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <b>Responsibility: Village/Families</b></li> </ul>	<ul style="list-style-type: none"> <li>Main Road</li> </ul>	<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
Churches, primary school, pre-school and houses in CFHZ	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings.</li> <li>To relocate outside CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal flooding. <b>Responsibility: Village/Families</b></li> </ul>	<ul style="list-style-type: none"> <li>Main Road</li> </ul>	<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>

NOTE: Consideration has been given to a new road 1200m long to provide for a development area outside of the CEHZ and CFHZ. The estimated cost of the road is \$T156,000 and an economic analysis shows that the cost of the road would be more than three times the benefits it would provide. Consideration has also been given to the development of the sand-spit for tourism, including the construction of a footbridge from the mainland. Any decision on the commercial development of the area must be made by the commercial operators at the time of development subject to a full environmental assessment. A footbridge is not recommended because it is unlikely that it would provide any environmental, economic or social benefit. Alternately developing a new road along the sandspit would also need to take into account the possible negative impacts of construction and the likely increase in sand-mining that will be associated with such a development and the negative effect of such sandmining on the sandspit.



## Fusi



Development on the coast at Fusi showing suggested location of footbridge to the sand-spit.

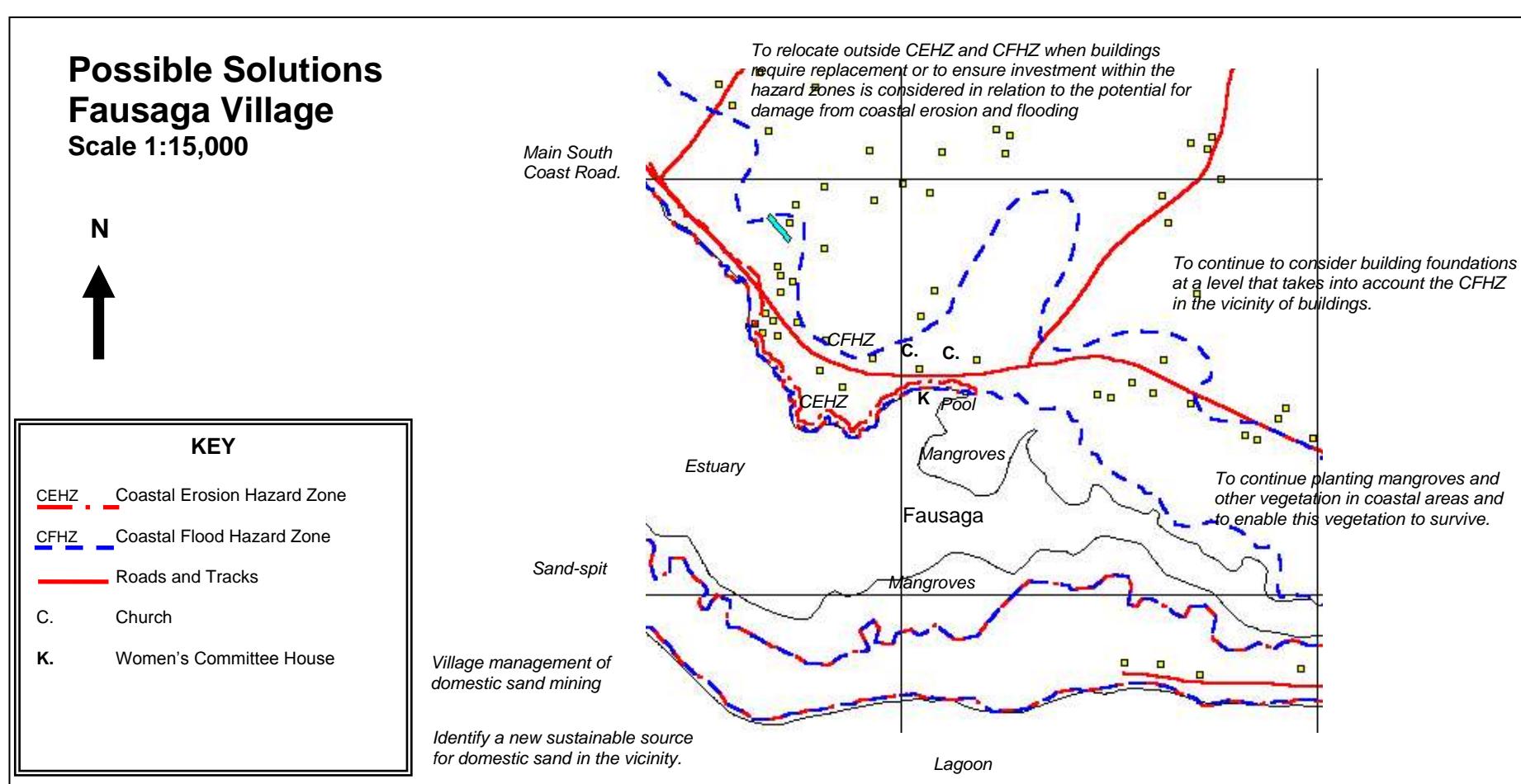


Little erosion along the inland coast of the estuary. Mangroves provide a line of protection and collect sediment around their roots.

## 8 Fausaga Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses, women's committee house and pool in CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <b>Responsibility: Village/DLSE</b></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <b>Responsibility: DLSE</b></li> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. <b>Responsibility: Families</b></li> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <b>Best Solution</b> <b>Responsibility: Village/Families</b></li> <li>To continue planting mangroves and other vegetation in coastal areas and to enable this vegetation to survive. <b>Responsibility: Village/Families</b></li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
Churches and houses in CFHZ	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings.</li> <li>To relocate outside CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal flooding. <b>Responsibility: Village/Families</b></li> </ul>	Main Road	<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>

NOTE: Consideration has been given to providing for village development by upgrading existing work roads. An economic analysis of this proposal on the basis of 500 m upgraded road costing \$T65,000 gives a benefit/cost ratio compared to the "Do Minimum" option of 0.11. This shows that the cost of implementing the option is twice the benefits of relocating the buildings in the CEHZ. There may be other benefits to providing upgraded work roads that lie outside the scope of the CIM Plan and the option is noted here for consideration by the appropriate authority. Consideration has also been given to the construction of a new seawall to provide protection to the committee house and village pool. An economic analysis shows that the costs of providing a 150m long wall will be more than 25 times the benefits it provides to the community. Consideration has also been given to the development of the sand-spit for tourism, including the construction of a footbridge from the mainland. Any decision on the commercial development of the area must be made by the commercial operators at the time of development subject to a full environmental assessment. A footbridge is not recommended because it is unlikely that it would provide any environmental, economic or social benefit. Alternately developing a new road along the sandspit would also need to take into account the possible negative impacts of construction and the likely increase in sand-mining that will be associated with such a development and the negative effect of such sand-mining on the sandspit.



### Fausaga



Mangroves grow bigger and form a dense wetland environment at the eastern end of the estuary.

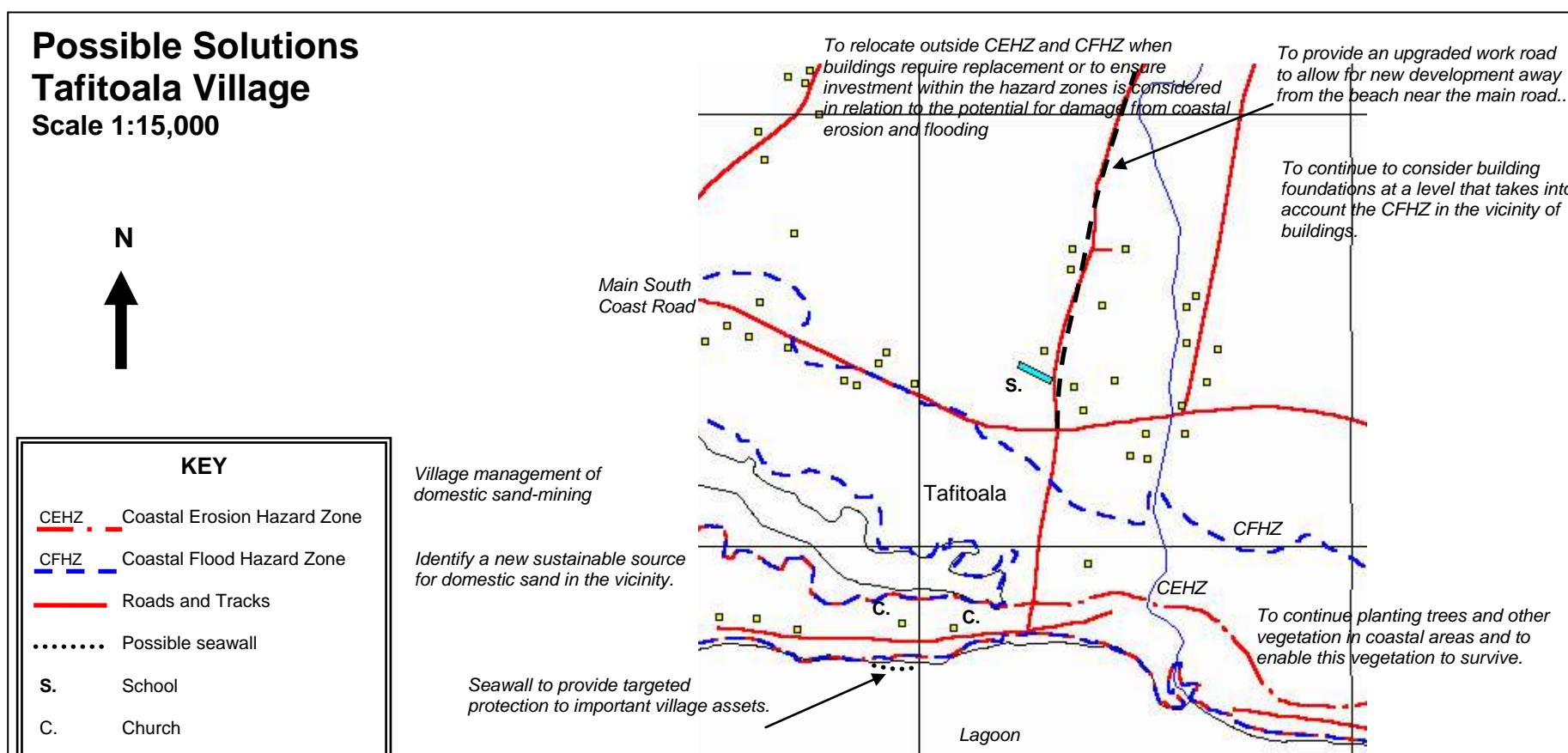


Village pool in front of the Women's Committee House at Fausaga.  
Mangrove wetland behind.

## 9 Tafitoala Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Houses and church in the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <i>Responsibility: Village/DLSE</i></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <i>Responsibility: DLSE</i></li> </ul> <ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. <i>Responsibility: Families</i></li> </ul> <ul style="list-style-type: none"> <li>To relocate outside CEHZ and CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <i>Responsibility: Village/Families</i></li> </ul> <ul style="list-style-type: none"> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> </ul> <ul style="list-style-type: none"> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul> <ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
Houses in the CFHZ	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings.</li> <li>To relocate outside CFHZ when buildings require replacement or to ensure investment within the hazard zones is considered in relation to the potential for damage from coastal flooding. <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> </ul> <ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
All infrastructure in the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>To provide an upgraded work road to allow for a new development area away from the beach near the main road. An economic assessment for an upgraded work road near the Main South Coast Road indicates that the benefits of providing it are greater than the costs compared to the do minimum option.</li> </ul> <p>Length of upgraded road 500m Cost of construction \$T115,000 Benefit/cost ratio 1.89</p> <p><b>Best Long-term Solution</b></p> <ul style="list-style-type: none"> <li>A seawall to provide targeted protection for the most important assets of the village (Church, Pastor's house and assets in the vicinity). Length of seawall 100m Cost of construction \$T41,000 Benefit/cost ratio 2.02</li> </ul> <p><i>Responsibility: Village/PWD</i></p>		<ul style="list-style-type: none"> <li>Government to investigate upgrading work roads including Environmental Impact Assessment.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul> <ul style="list-style-type: none"> <li>Prepare Environmental Impact Assessment in accordance with Step 6 of the CIM Strategy Evaluation Method.</li> <li>Seek funding and prepare contract documentation.</li> </ul>

NOTE: Widening the single-lane bridge on the Main South Coast Road is a matter raised in consultation that is outside of the scope of this plan. It is noted for further consideration by PWD.



### Tafitoala



Village access road along the coast at Tafitoala.

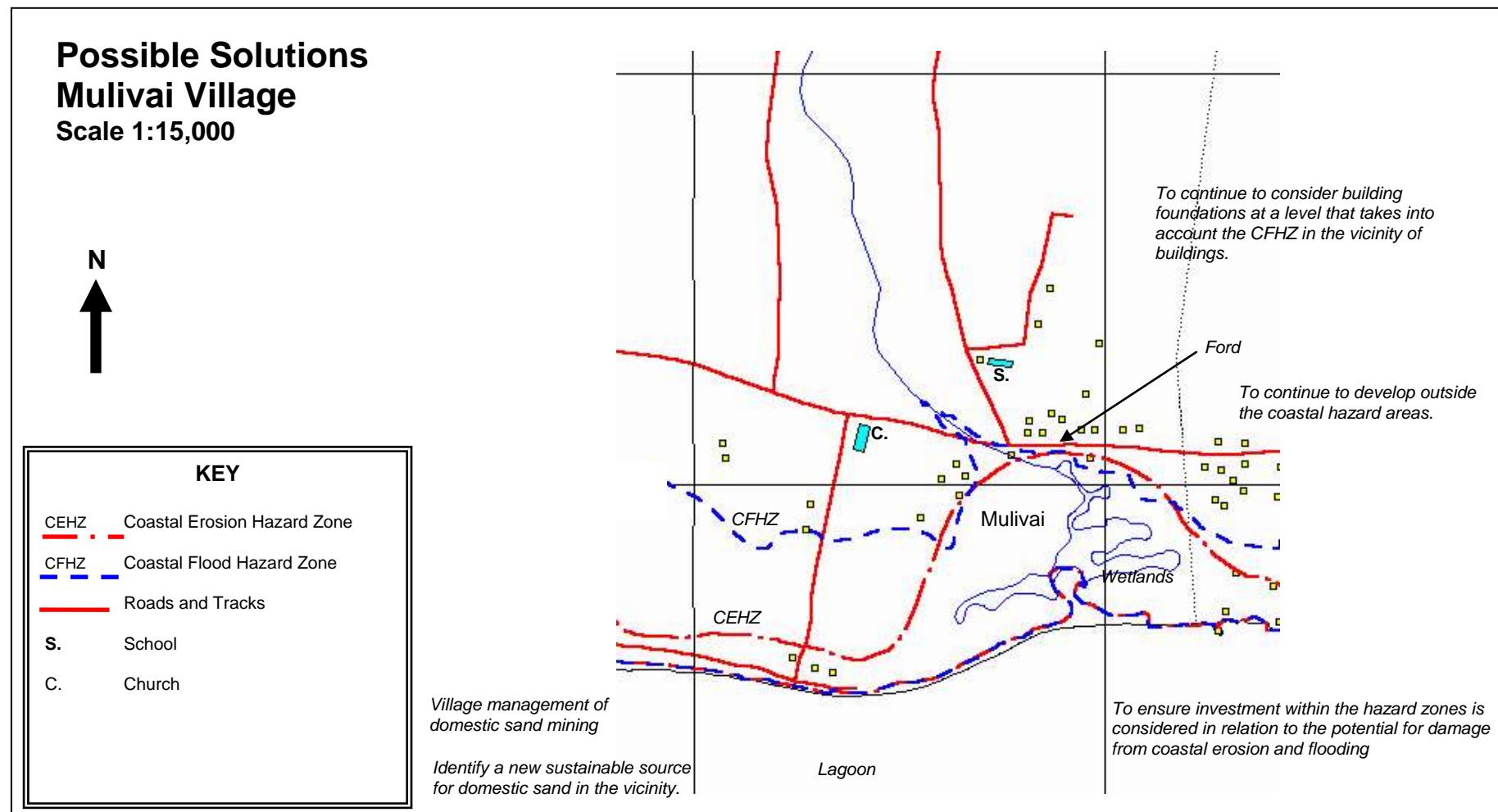


Village seawall in front of church house at Tafitoala showing degree of erosion around the end of the wall.

## 10 Mulivai Village Infrastructure

Infrastructure	Best Solutions and Other Solutions Proposed	Other Benefits	Implementation Guidelines
Village houses in the CEHZ and CFHZ	<ul style="list-style-type: none"> <li>Village management of domestic sand mining <i>Responsibility: Village/DLSE</i></li> <li>Identify a new sustainable source for domestic sand in the vicinity. <i>Responsibility: DLSE</i></li> </ul>		<ul style="list-style-type: none"> <li>Village to share with government control over sand mining activities.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue to consider building foundations at a level that takes into account the CFHZ in the vicinity of buildings. <i>Responsibility: Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Identify specific sites for near shore sustainable sand mining to meet domestic demand without depleting coastal resources.</li> <li>Prepare Environmental Impact Assessments for identified sites.</li> <li>Undertake consultation with villages affected by the proposed sand mining.</li> </ul>
	<ul style="list-style-type: none"> <li>To ensure investment within the hazard zones is considered in relation to the potential for damage from coastal erosion and flooding <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Family decision when building to provide long-term protection from flooding.</li> <li>Village/Family decision to relocate in the long-term or when building new houses.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue to develop outside the coastal hazard areas. <b>Best Solution</b> <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Village to promote development outside the coastal hazard areas.</li> </ul>
	<ul style="list-style-type: none"> <li>To continue planting trees and other vegetation in coastal areas and to enable this vegetation to survive. <i>Responsibility: Village/Families</i></li> </ul>		<ul style="list-style-type: none"> <li>Village/Families to recognise the role that vegetation plays in stabilising coastal areas.</li> <li>Areas of accretion to be planted as soon as practicable with suitable coastal species.</li> </ul>

NOTE: Widening the single-lane bridge at Tafitoala and replacing the ford at Mulivai with a bridge on the Main South Coast Road have been raised as issues in consultation. These matters are outside of the scope of this plan. Upgrading the work road has also been considered to provide for future development but there is only one occupied house that is located in the CEHZ and it is not necessary to upgrade the work road to meet the objectives of the CIM Plan. However, it may be appropriate to upgrade the work road to provide for other aspects of village welfare. These points are noted for further consideration by PWD. The maintenance and upgrade of the existing coastal access road has also been considered in the assessment of solutions for Mulivai Village. The assessment shows that upgrading the access road will not improve the overall level of the resilience for the village and will increase the likelihood of future investment being exposed to damage.



## 11 *Mulivai*



Remains left from commercial sand-mining.



Remains of the Hideaway Hotel destroyed in cyclones Ofa and Val. Future hotel development proposed for this area.